CALIFORNIA DIVISION OF MINES AND GEOLOGY

Fault Evaluation Report FER-29

February 25, 1977

1. Name of faults: Lion Canyon fault, Big Canyon fault, Sisar fault, and other related faults near the Ojai and Upper Ojai Valleys.

2. Location of faults: Matilija, Ojai, and Santa Paula Peak 7.5' quadrangles, Ventura County (see index map).

3. Reason for evaluation: Part of a 10-year program. Most of these faults are zoned as either primary or secondary fault hazards in the Ventura County Seismic and Safety Element (Nichols, 1974).

4. References:

a) Bertholf, H.W., 1967, Geology and Oil Resources of the Timber Canyon area, Ventura County, California: Unpublished M.S. thesis, University of California, Los Angeles, 56 p., 10 plates, geologic map scale 1:12,000.

b) Bush, G.L., 1956, Geology of Upper Ojai Valley: Unpublished M.A. thesis, University of California, Los Angeles, 60 p., 10 plates, geologic map scale 1:12,000.

c) Dibblee, T.W., Jr., 1939, Unpublished geologic map of the Santa Paula quadrangle, scale 1:62,500.

d) Dibblee, T.W., date unknown, Geologic map of Ventura quadrangle: Unpublished, scale 1:62,500.

e) Jennings, C.W., 1975, Fault map of California with locations of volcanoes, thermal springs, and thermal wells: California Division of Mines and Geology, California Geologic Data Map Series, Map no. 1, scale 1:750,000.

f) Jennings, C.W., and Strand, R.G., 1969, Geologic map of California, Los Angeles sheet: California Division of Mines and Geology, scale 1:250,000.

g) Kew, W.S.W., 1924, Geology and ~~O~~il ~~R~~esources of a part of Los Angeles and Ventura Counties, California, U.S. Geological Survey Bulletin 753, 202 p., 2 plates, map scale 1:62,500.

h) McCullough, T.M., 1957, The Geology of the Timber Canyon area, Santa Paula Peak quadrangle, Ventura County, California: Unpublished M.A. thesis, University of California, Los Angeles, 67 p., 6 plates, geologic map scale 1:18,000.

i) Nichols, D.R., October 1974, Surface Faulting <u>in</u> Seismic and Safety Elements of the Resources Plan and Program, Ventura County Planning Department, section II, p. 1-35, plate 1.

j) Putnam, W.C., 1942, Geomorphology of the Ventura ~~R~~egion, California: Geological Society of America Bulletin, v. 53, no. 5, p. 691-754, 5 plates, 11 figures.

k) Schlueter, J.C., 1976, Geology of the Upper Ojai-Timber Canyon area, Ventura County, California: Unpublished M.S. thesis, Ohio University, 76 p., geologic map scale 1:12,000.

l) Smith, T.C., January 1977a, Arroyo Parida and Santa Ana faults: California Division of Mines and Geology, Fault Evaluation Report FER-26 (unpublished).

m) Smith, T.C., January 1977b, San Cayetano fault: California Division of Mines and Geology, Fault Evaluation Report FER-19 (unpublished).

n) Weber, H.F., Jr., Cleveland, G.B., Kahle, J.E., Kiessling, E.F., Miller, R.V., Mills, M.F., Morton, D.M., and Cilweck, B.A., 1973, Geology and mineral resources study of southern Ventura County, California: California Division of Mines and Geology, Preliminary Report 14, 102 p., map scale 1:48,000.

o) Weber, F.H., Jr., Kiessling, E.W., Sprotte, E.C., Johnson, J.A., Sherburne, R.W., and Cleveland, G.B., 1975, Seismic hazards study of Ventura County, California: California Division of Mines and Geology, open file report 76-5LA, 396 p., 9 plates.

p) Yeats, R.S., Schlueter, J.C., Butler, M.L., and Çemen, Ibrahim, 1976, Santa Susana-San Cayetano-Red Mountain fault system: Subsurface geology, mechanical analysis and displacement rates: Unpublished summary report for U.S. Geological Survey, contract no. 14-08-0001-15886.

q) Ziony, J.E., Wentworth, C.M., Buchanan-Banks, J.M., and Wagner, H.C., 1974, Preliminary map showing recency of faulting in coastal southern California: U.S. Geological Survey, Miscellaneous Field Studies Map MF-585, 15 p., map scale 1:250,000, 3 pl.

5. Summary of available data: Most of the faults discussed in this report are zoned as secondary fault hazards in the Ventura County Seismic and Safety Element (Nichols, 1974, after Weber, et al., 1973). *Essentially all known faults were zoned in the element.*

The Ojai and Upper Ojai Valleys area is the site of a complex junction of the Santa Ana fault (see Smith, 1977a), San Cayetano fault (see Smith, 1977b), and several other faults. Some of these faults are south-dipping thrusts, some are north-dipping thrusts, and at least one may be a strike-slip fault that has had a moderately large vertical component of movement. The literature available on each fault is discussed below.

Sisar Fault

Bush (1956) describes the Sisar fault as a south-dipping thrust (west of Santa Paula Creek) of middle to late Pleistocene age. He depicts the Sisar as cutting the Pico Formation (Pliocene) and not cutting Holocene fanglomerate.

Bertholf (1967) describes the Sisar fault as a "system" of three or more east-west trending, high-angle reverse faults which converge near Timber Canyon where these faults are overridden by the San Cayetano fault. He notes that the Sisar fault almost parallels the surrounding strata, which are partly overturned. Both Schlueter (1976, p. 40-42) and Bertholf state that the Sisar fault is partly overturned (folded). West of Camp Bartlett, the Sisar fault dips southward; east of Camp Bartlett it dips northward. Schlueter suggests that the Sisar system represents a series of original southward-dipping reverse or thrust faults which have been overturned (folded) by later movement along the north-dipping San Cayetano fault. Bertholf depicts the Sisar fault as not cutting older (late Pleistocene) terrace deposits in four separate locations. McCullough (1957) agrees with Bertholf's conclusions. He determined (from subsurface data) that the fault dips 62° northward in his field area, acknowledging the fact that the fault dips southward west of the creek. Schlueter (p. 41) notes that the Sisar fault has (vertically) offset stream terraces (late Pleistocene) in Santa Paula and Sisar Creeks. He feels that this displacement is due to the influence of the San Cayetano fault.

Weber, et al. (1975, p. 174) felt that the Sisar fault dips gently southward. "Low, modified scarps in older alluvium at east edge of upper (sic) Ojai Valley suggests youthfulness" (of the Sisar and Big

Canyon faults). They determined that the probable age of latest movement for the Sisar fault was late Quaternary.

Big Canyon Fault

Bush (1956) described the Big Canyon fault as a south-dipping thrust fault. He noted that the youngest unit cut is Pico Formation (Pliocene), and that a Holocene fanglomerate was not offset by the fault. Bush determined that the Sisar fault overrides the Big Canyon fault. He, therefore, concluded that the Big Canyon fault was older than the Sisar. Schlueter (1976, p. 34-37), felt that the Big Canyon fault is a normal fault that dips to the north, at depth, and has been overturned (folded) by the Sisar fault near the surface. But he did not reach any definite conclusions about the sense of fault movement.

Nichols (1974, p. 11-9) states that the Big Canyon fault may displace Pleistocene terrace deposits (but he doesn't say where). He also notes that there have been no historic earthquakes in the general area of the fault. Weber, et al. (1975, p. 174) as noted above, cite the presence of low, modified scarps near the Big Canyon and Sisar faults (see plate 2). They concluded that the Big Canyon fault was a north-dipping thrust, and was probably active during the late Quaternary.

Lion Canyon Fault

Weber, et al (1975, p. 174) named the Lion Canyon fault zone, which extends from Santa Paula Creek to the Oak View-Casitas Lake area. They describe this zone as a zone of generally south-dipping, reverse faults. Landslides obscure the relationships of many of the faults. They determined that faulting is of questionable Holocene age, based on scarps, tilted alluvium, and displacement of gravels of Quaternary age in the Lion Canyon and Oak View areas. However, many of these scarps may not be due to faulting, but could be entirely erosional in origin. Also, the assignment of a Holocene (?) age to the faulting of undifferentiated (Quaternary) alluvium would appear to be open to serious question.

Nichols (1974, p. 11-9) refers to the "Lion Mountain" fault. He states that the fault may displace Pleistocene terrace deposits (but, again, he does not say where). He also notes that there have been no historic earthquakes in that general area.

Bush (1956), refers to the "Lion"fault (this fault coincides with the Lion Canyon fault of Weber, et al). He describes this fault as a south-dipping thrust with approximately 1,500 feet of displacement since the end of Pliocene time. Bush believed that the Lion fault was probably older than the Big Canyon fault, and noted that Holocene alluvium was not cut by the Lion fault. Schlueter (1976) agrees with Bush's interpretation.

Other Faults

Weber, et al. (1975, plate), show several other faults, which may or may not be a part of the Lion Canyon zone (the reference was unclear on this fact) as offsetting terrace deposits (see plate 1 herein). The primary evidence cited for the existence of these faults are several escarpments (see also item 7).

6. <u>Interpretation of aerial photographs:</u>

U.S. Department of Agriculture aerial photographs, series AXI, flights 4K, 7K, 8K, and 9K, scale 1:24,000, flown in 1953 were viewed stereoscopically. Individual phototraphs and features observed are noted on plates 1, 2, and 3. Many of these faults are quite recognizable on these photos. (Some of the faults shown by Weber, et al (1975), were probably drawn solely on the basis of these features.) Other "fault features" either were not well-defined, or could be explained as erosional features (may not be due to faulting).

7. Field observations:

The complex system of faults (or suspected faults), the limited time, and limited exposures made the task of field checking rather overwhelming.

A scarp adjacent to State Highway 150 (sec. 11, T. 4 N., R. 22 W., near the windmill depicted on plate 2 was examined. This scarp sloped 5 degrees to the south and was about 10 feet high. There was no apparent change in lithology across the scarp. No roadcuts are present in this location. Calling this a fault feature would be highly speculative without trenching.

Where Sulphur Mountain Road crosses the Lion Canyon fault, I could observe no features that convinced me that this fault is active. There is a curvilinear front to Sulphur Mountain, but this could be explained by stream erosion and deposition (of alluvium), perhaps ~~an~~ on a fault-line ~~an older fault surface~~ scarp; however, I did not observe any evidence of the faulted alluvium shown by Weber, et al (1975).

The Sisar and Big Canyon faults cross Sulphur Mountain Road in a landslide area. Some shear planes (single fractures) were noted, but these could entirely the result of slope failure and not large scale faulting. Displacement on each of these fractures appeared to be limited to less than two or three feet.

In the Matilija quadrangle, northeast of Oak View, Weber, et al. (1975) noted several northeast-trending escarpments. I attempted to examine these scarps on October 20, 1976. The area had been graded and ~~that~~ houses ~~had~~ have been or ~~were~~ are ~~bring~~ being built in the area. I noted no evidence, except for some of the scarps (others had been modified by grading), that would indicate the terrace deposits were faulted. These deposits lacked sorting and bedding, thus, these faults may be quite difficult to recognize at the surface (or in a trench).

8. Conclusions: Based on the small amount of work that was done and the extreme complexity of faulting, any conclusions reached must be considered tentative. It does appear that there are probably several late Quaternary faults in the Ojai and Upper Ojai Valleys area. Although no direct observations of faulted terrace materials were made, scarps in terrace deposits are highly suggestive that many of these faults are present.

The literature suggests that the Sisar fault is an older, pre-San Cayetano structure. However, the Sisar fault in the Santa Paula Peak quadrangle could have had sympathetic movement with that of the San Cayetano fault. Recently acquired information (Yeats, et al., 1976; and Schlueter, 1976) suggests that the Sisar fault cuts late Pleistocene stream gravels of Santa Paula Creek. Further work is being conducted by Yeats and others, and should be reviewed when the results become available. This data is in conflict with Bertholf's data that late Pleistocene terrace deposits are not cut by the Sisar fault. Thus, it would appear that the Sisar fault may have been active, at least in part, during the late Quaternary. However, there is no available conclusive evidence of Holocene movement on the Sisar fault. In any case, one may consider the Sisar fault in the Santa Paula Peak quadrangle as a branch of the San Cayetano fault (see Smith, 1977b).

The Big Canyon fault may be late Pleistocene in age (Weber, et al. 1975; Nichols, 1974). However, there is no evidence of Holocene activity along the fault.

The Lion Canyon fault is probably late Quaternary. Weber, et al., (1975) assigns a Holocene (?) age to this fault, however, neither Bush (1976), nor Schlueter (1976), nor I could find any evidence of Holocene movement along the Lion Canyon fault.

Several unnamed faults are present in the area studied. Some of these are probably ~~late~~ late Pleistocene in age, however, there is no conclusive evidence that any of these faults have been active during Holocene time.

In general, the whole Ojai and Upper Ojai Valleys area is a complex zone of faulting. There is considerable confusion in the literature as to which fault zone many of the individual traces belong. It may prove extremely difficult to determine the relationship of any fault discovered at any one site to any of the major faults or fault zones.

9. Recommendations:

Based on the data summarized herein, none of these faults should be zoned at this time. Additional data may be forthcoming from Yeats and others. This data should be reviewed, and any necessary additional evaluation (by A-P staff) completed and summarized in an addendum report.

10. Investigating geologist's name; date:

Theodore C. Smith
Assistant Geologist
February 25, 1977

I agree with recommendations.
EWH.
3/10/77